Preliminary Studies on the Seasonal Variation in Starch Content of Bamboos in Kerala State and its Relation to Beetle Borer Infestation

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(*With two graphs*)

The starch content in felled bamboos has long been recognized to be essentially correlated with their susceptibility to attack by beetle borers. Beeson (1941) observed that there is fluctuation in the concentration of starch in living bamboos in the different seasons. Gardner (1945) noted that at Dehra Dun starch content in the living culm varied with the season. It was highest in May and June, decreased with the commencement of the monsoon in July to the end of August, remained constant in September, rapidly decreased to the minimum level in November-December, and once again rose to reach the maximum in May. It was also seen that the degree of attack on felled bamboo by beetle borers, which need starch for their development, is correlated with the variation of starch content in the culm. In view of this observation the months July to January were considered safe, under Dehra Dun conditions, for felling bamboos, ensuring least attack by beetle borers. Jones (1948) conducted some trials under climatic conditions prevailing in Travancore (now Kerala), and found the months June and July as the safe period to fell bamboos. Plank and Hageman (1951) noted a positive correlation existing between starch content in different varieties of bamboos and their susceptibility to powder-post beetle infestation.

The present paper embodies the results of further studies made in continuation of those already reported (Jones, 1948). The main purpose of these studies has been to ascertain the most favourable period for felling bamboos ensuring least borer infestation under conditions prevailing in Kerala.

MATERIALS AND METHODS

Culms used in the present investigations were selected from well-established clumps of *Bambusa arundinacea* Willd., growing wild in the reserve forest at Kallar (near Trivandrum). Ten pieces, each five feet long, cut out from the basal region, were collected at random every month from culms of about two years' growth. Three rings, each two inches long, were cut out from three of these pieces chosen at random and analysed for starch content. A.O.A.C. methods of analysis were used. Of the ten pieces collected each month, five were split lengthwise each into two equal halves, and five kept unsplit. The split and unsplit pieces were all kept exposed to natural beetle infestation. After one year under storage the pieces were examined for borer attack, the degree of infestation being assessed by noting the number of holes on the pieces made by the borer beetles.

The species of beetles found attacking bamboos are *Dinoderus minutus* Wlk., and *Minthea rugicollis* Wlk.

RESULTS

Starch content of bamboos in different seasons:

Table I gives the concentration of starch in monthly samples of bamboo collected during the period April 1948 to March 1949. Figure 1 represents the same. It will be seen that the concentration is highest in February, decreases gradually till the end of May, and shows a sudden drop from June, reaching the lowest level in July and August. A good increase is registered in September and a slight drop in October and November. From then onwards the starch concentration rises gradually to the peak point once again.

TABLE I

Monthly starch content of bamboo during the period April '48 to Mar. '49

Month	Starch content % of samples			Average starch content	Standard deviation
	I	II	III		
1	2	3	4	5	6
January ..	15.15	16.42	15.28	15.75	0.4864
February ..	19.70	19.20	18.10	19.02	0.6749
March ..	14.80	16.45	16.16	15.80	0.7891
April ..	12.52	13.17	12.07	12.59	0.3464
May ..	14.37	12.79	10.16	12.14	0.7365
June ..	11.96	19.56	14.52	15.36	3.1544
July ..	9.04	8.70	9.51	9.08	0.4133
August ..	8.84	10.97	10.56	10.12	0.9586
September ..	14.68	14.20	15.78	14.89	0.5815
October ..	11.49	12.55	14.84	12.95	1.4354
November ..	14.96	12.70	13.05	13.57	0.9932
December ..	15.28	20.79	13.60	16.56	3.0530

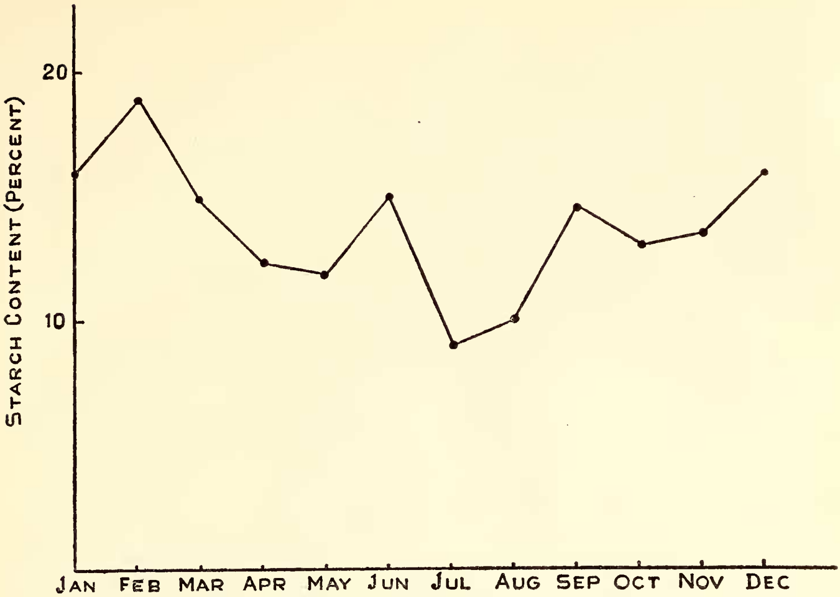

Fig. 1. Monthly variation in starch content in bamboo in Kallar (Kerala State)

Analysis of variance is given in Table II. It is seen that 'F' is very highly significant, the 1% value being equal to 3.09, indicating that the variation in starch content from month to month is highly significant. Now, critical difference $= \sqrt{\frac{2 \times 3{\cdot}534}{3}} \times t_0$ where t_0 is the value of 't' from 't' tables corresponding to d.f. 24 and significant level 0.05, or $\sqrt{\frac{2 \times 3{\cdot}534}{3}} \times 2{\cdot}064 = 3{\cdot}168$. According to this the months of the year can be graded into four groups based on starch content, as shown in Table III. It is seen that starch content is low in July and August, moderate in April to June and September to November, high in December to January and March and very high in February.

TABLE II

Analysis of variance of data in Table I

Source of variation	Sum of squares	Degrees of freedom	Variance	F
Between months	256.7714	11	23.343	6.605
Remainder	84.8165	24	3.534	
Total	341.5879	35		

TABLE III

Grouping of months according to starch content in bamboo

Degree of starch content	Months	Average starch content in the months included in the group%
Low ..	July, August	9.60
Moderate ..	April, May, June, Sept., Oct., and November	13.63
High ..	Dec., Jan., and March	16.04
Very high ..	February	19.02

Starch content and its relation to borer attack:

Data on the intensity of borer attack on bamboos felled during the months grouped above are given in Table IV. Statistical analysis shows that the values of chi. squares of independence for unsplit and split bamboos are 18.5 and 10.43 respectively.

TABLE IV

Relation between starch content and borer attack

Month group	Degree of starch content	No. of pieces showing different ranges of borer holes				
		I Less than 10	II 11 to 50	III 51 to 150	IV Above 150	Total
July, Aug.	Low (a)	10				10
	(b)	4	6			10
April to June & Sept. to Nov.	Moderate (a)	24	4	1	1	30
	(b)	8	15	1	6	30
Dec., Jan., Mar.	High (a)	7	2		6	15
	(b)	6	2		7	15
February	Very high (a)	2			3	5
	(b)	2			3	5
Total	(a)	43	6	1	10	60
	(b)	20	23	1	16	60

(a) denotes unsplit and (b) split pieces.

In the case of unsplit bamboos the value of chi. square 18.15 has a probability of being exceeded only less than 0.05 and therefore is very significant. In the case of split bamboos, however, the probability of exceeding the calculated chi. square value lies between 0.30 and 0.20 and hence the assumption of the existence of an association does not seem quite justified. This is unexpected, and an explanation for it does not appear possible with the present data.

The correlation between the concentration of starch in bamboos and the highest intensity of borer attack has, however, been found to be very significant. The results of the observations are given in Table V and represented in Fig. 2. It will be seen that for split as well as unsplit bamboos the percentage of pieces showing the maximum intensity of borer attack is highest in the lot showing 'very

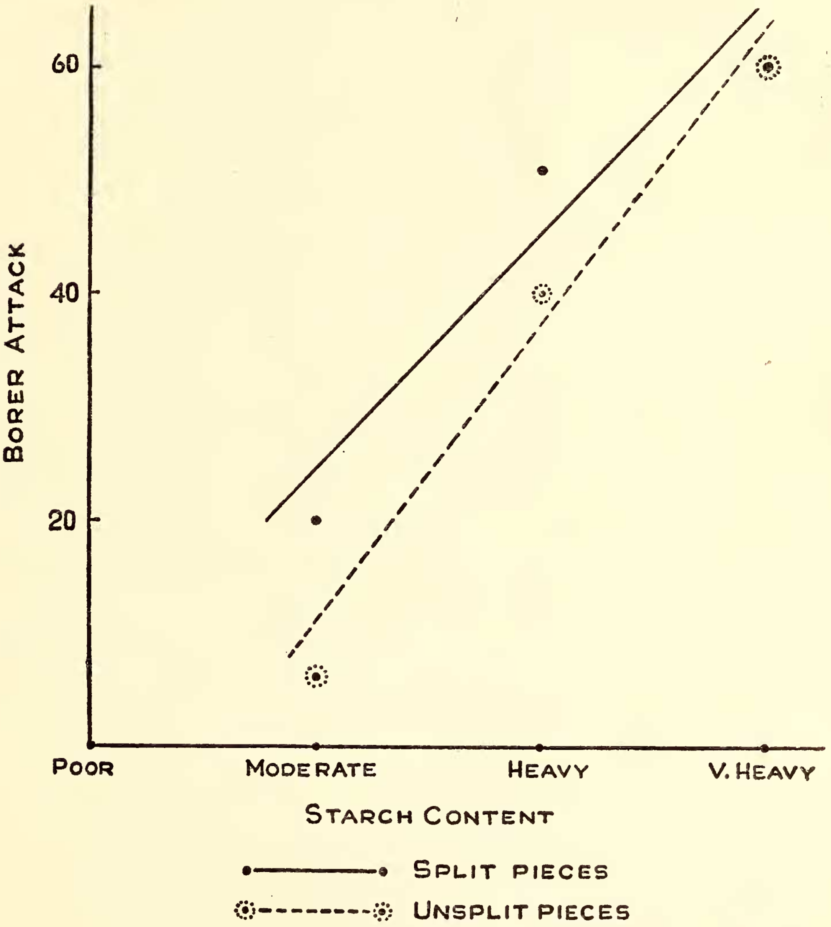

Fig. 2. Association between starch content and borer attack

high' starch concentration, this being followed in the descending order by lots with 'heavy' and 'moderate' concentrations.

TABLE V

Starch content in relation to highest intensity of borer attack (Percentage of bamboo pieces showing more than 150 holes)

Group	Starch content				Total
	Poor	Moderate	Heavy	Very heavy	
Split pieces ..	0	20.00	46.67	60.00	16.67
Unsplit pieces ..	0	3.33	40.00	60.00	26.67

DISCUSSION

Depletion of starch in bamboos has been attributed to rains and the growth of new culms (Gardner, 1945). The present findings lend support to this observation. It is seen that with the pre-monsoon showers in March to May there is appreciable depletion of starch, and following heavy monsoon showers in June-July there is a sharp drop. This period is also characterised by vigorous growth of new culms. The cessation of rains and the subsequent lowering of growth rate of bamboos result in increased accumulation of starch as reserve food. It is also seen that the 'starch high' and 'starch low' months in Dehra Dun and Kerala are different. In Kerala, starch concentration is highest in February and least in July-August. The present investigations confirm the observation recorded by previous workers that a positive correlation exists between starch content and borer attack. Based on this information it may be inferred that the best time for felling bamboos in Kerala would be during the months July and August.

SUMMARY

Concentration of starch in bamboo felled in the different months of the year in Kerala shows significant monthly variations. Based on the concentration of starch, the months of the year fall under four groups, namely (1) July and August showing low concentration (9.60% average); (2) April to June and September to November, showing moderate concentration (13.63%); (3) December, January, and March showing high concentration (16.04%); and (4) February, showing very high concentration (19.02).

Starch content and intensity of borer attack on felled bamboos are positively correlated. The best time to fell bamboo in Kerala, ensuring minimum attack by beetle borers, is during the months July and August.

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